STATE OF WASHINGTON

STATE BUILDING CODE COUNCIL

Washington State Energy Code Development

Standard Energy Code Proposal Form

Log No. 079 Revised

Code being amended: ☐ Commercial Provisions ☒ Residential Provisions

Code Section #: Table R402.1.2

Brief Description:

This measure improves residential window insulation through modifications to the U-factor requirements in WSEC-R Table R402.1.2, as outlined in the table below.

Reduce prescriptive window U-Factor requirement to 0.28 (weighted average).

U-Factor weighted average of 0.28 should be fairly noncontentious as at the time of this proposal, U-0.28 windows were unanimously recommended for approval for inclusion in the 2024 IECC by the Residential Envelope subcommittee (see REPI-28-21 as modified). This consensus included window and glazing industry support, implying that U-0.28 is a reasonable efficiency level to require for 2021 WSEC-R. In addition, Oregon has already adopted U-0.27 windows into their base energy code. As such, industry windows that more than exceed the efficiency level proposed here are widely available in the Pacific Northwest.

Purpose of code change:

Windows are an important component of the energy performance of any house. In many new homes windows represent just 6-8% of the envelope area but 45 to 49% of the total envelope heat loss. As one of the primary barriers between indoor and out, the openings of the building envelope; high performance windows , doors, and skylights (fenestration) are essential to an energy efficient building. The typical ~R3 code compliant or ENERGY STAR® v6 window in common use in the United States is double glazed and despite dramatic improvements in fenestration technologies in recent years, such as the adoption of Low-E window technology in the 1990s , a period when almost all windows installed in homes were clear glass, we only saw gains of a reduction of U factor down to a weighted average of 0.24. A shift from double to triple glazing, ~ R4.6 to 5.3, would reduce window heat loss and improve comfort.

As the ENERGY STAR® Program moves to lower U-Factors for compliance in v7.0, anticipated to be adopted for 2023, this proposal aligns the 4C and 5B prescriptive requirements with the existing ENERGY STAR® v6.0 Program equivalent energy performance.

Table 4: Equivalent Energy Performance for Windows		
Climate Zone	**U-Factor**[1]	**SHGC**[2]
Northern*	= 0.28	≥ 0.32
	= 0.29	≥ 0.37
	= 0.30	≥ 0.42

* The effective date for the Northern Zone equivalent energy performance criteria for windows is January 1, 2016.

[1] Btu/h ft^2·°F
[2] Solar Heat Gain Coefficient

Prescriptive requirements to this level make use of technology already in the marketplace , driving adoption of higher performance windows in a readily adoptable package.

The window improvements proposed here will pay off within roughly 23-31 years based on recent analysis conducted as part of the ENERGY STAR® Windows, Doors, and Skylights Version 7.0 update process and in the following analysis for climate zones 4C and 5B.

Your amendment must meet one of the following criteria. Select at least one:

☐ Addresses a critical life/safety need.

☐ The amendment clarifies the intent or application of the code.

☒ Addresses a specific state policy or statute. (Note that energy conservation is a state policy)

☐ Consistency with state or federal regulations.

☐ Addresses a unique character of the state.

☐ Corrects errors and omissions.

Check the building types that would be impacted by your code change:

☒ Single family/duplex/townhome

☒ Multi-family 1 – 3 stories

☐ Multi-family 4 + stories

☐ Commercial / Retail

☐ Institutional

☐ Industrial

Your name	Dan Wildenhaus	Email address	dwildenhaus@trccompanies.com
Your organization	TRC and BetterBuiltNW	Phone number	772-932-4994
Other contact name	Click here to enter text.		

Economic Impact Data Sheet

Is there an economic impact: ☒ Yes ☐ No

Briefly summarize your proposal's primary economic impacts and benefits to building owners, tenants, and businesses. If you answered "No" above, explain your reasoning.

Homeowners will have lower utility bills when presented with lower U-Factor windows.

Provide your best estimate of the **construction cost** (or cost savings) of your code change proposal? (See OFM Life Cycle Cost **Analysis tool** and **Instructions;** use these **Inputs**. **Webinars on the tool can be found Here and Here**)

$1.22/square foot (For residential projects, also provide **$402.60**/ dwelling unit)

Show calculations here, and list sources for costs/savings, or attach backup data pages

Costs for window upgrades

Costs for moving to 0.28 from 0.30 U Factor windows was estimated using builder interviews and ENERGY STAR® v7.0 window specification analysis.

Source/U Factor	Target U 0.28
Builder interviews	$1.85/sq ft
ENERGY STAR	$1.57/sq ft
ICF IECC Cost Eff Analysis	$0.25/sq ft
Average	$1.22/sq ft
For Prototype Home	$402.60

Builder cost estimates (per sq ft):

- Builder A - $2.00
- Builder B - $1.10
- Builder C - $2.45
- Average - $1.85

Builder interviews consisted of two regional builders and one non-profit affordable housing builder. These three builders represent approximately 300 homes a year built in Washington State in both climate zones. Builders reported costs in late 2021, which were an increase of at least 30% when compared to early 2020.

ENERGY STAR cost estimates (per sq ft):

Assumed 15% glazing on 2,380 sq ft home (357 sq ft glazing):

- 0.27 windows Northern Climate = $1.19
- 0.28 windows Northern-Central Climate = $0.50
- 0.26 windows IECC Climate Zone 5 = $1.93
- Average = $1.21
- 130% inflation = $1.57

ICF-2021-IECC-Cost-effectiveness-Analysis report

Assumed 15% glazing on 2,380 sq ft home (357 sq ft glazing):

- 0.32 to 0.30 = $67/house or $0.19/sq ft
- 130% inflation = $87.1 or $0.25/sq ft

Provide your best estimate of the **annual energy savings** (or additional energy use) for your code change proposal?

Click here to enter text.KWH/ square foot (or) **0.177** KBTU/ square foot of home

0.05 $/ square foot of window area

(For residential projects, also provide **388.5** KWH/KBTU / dwelling unit)

16.50 $/ dwelling unit

Show calculations here, and list sources for energy savings estimates, or attach backup data pages

Savings for window upgrades

CZ	Heating system	Case	Modeled Heating and Cooling costs $/yr	Modeled Heating and Cooling savings $/yr	Modeled Heating and Cooling savings KBTU/yr	ENERGY STAR savings $/yr	Blended Savings $/yr
4C	Gas furnace	Base U 0.30	633				
		Proposed U 0.28	619	14			
	Heat Pump	Base	656		17,269		
		Proposed	643	13	16,918		
5B	Gas furnace	Base U 0.30	1003				
		Proposed U 0.28	987	16			
	Heat Pump	Base	1184		31,449		
		Proposed	1167	17	31,023		
All	All	Averaged and Total		$15	388.5	$18	$16.50

These estimates come from assumption of a 2,200 sq ft prototype home on a vented, enclosed crawl space with 3 bedrooms. 15% glazing of window to CFA assumed.
Homes were modeled with 2021 WSEC-R Integrated Draft Prescriptive elements, and federal minimum standard equipment (HP homes followed 2018 WSEC-R requirement to have a single DHP providing 60% of the heating load) only to see impact on base case of home.
Heating and Cooling savings were calculated in REM/Rate v16.0.6
Energy Costs used 2021 EIA average rates
ENERGY STAR savings were lowest average savings estimates available in the "*ENERGY STAR® Windows, Doors, and Skylights Version 7.0 Criteria Analysis Report*" – July 2021

For Cost Effectiveness, the LCCA Tool from the Office of Financial Management was used:

While the per sq ft costs are low for upgrading windows, so are the savings.

When using a 40-year measure life, this is cost effective.

The analysis for cost effectiveness utilized four individual runs with the LCCA tool, for each comparing only the baseline to Alt 1, the same home with U-Factor 0.28 windows installed. The same size (2200 sq ft) was used and EIA average rates for natural gas and electricity were used ($0.95/Therm and $0.1007/kWh).

The results showed positive Net Present Savings and NPS with Social Cost of Carbon for three of the four scenarios when a 30-year measure life is associated.

The corresponding LCCA Tools (attached as part of the submission packet) provide the details for the analysis on cost effectiveness.

Cost Effectiveness

As indicated in the LCCA as mentioned above and using energy savings as described, Simple Payback was found to approximately 29.8 years in Seattle and 24.4 years in Spokane. Regardless of assumed measure life of windows, either 30 years (ENERGY STAR) or 40 years (Northwest Power and Conservation Council), this measure pays back within its lifetime. A 30-year measure life was used in the LCCA Tool. The Net Present Value and Net Present Value with Social Cost of Carbon were positive for Seattle homes with gas heating and both gas and heat pump heated homes in Spokane. The heat pump heated home in Seattle was close, but not positive. When the measure life in Seattle was switched to 40 years, the NPS with SCC would have both been positive as well.

Measure savings were reported heating and cooling savings as per the analysis outlined above.

CZ\Metric	Net Cost	Measure Savings	NPS w/o SCC	NPS w/ SCC	Simple Payback
Seattle HP	$402.60	129 kWh	(78)	(42)	31
Seattle HP 40-year measure	$402.60	129 kWh	62	99	31
Seattle Gas	$402.60	14.7 Therms	148	204	28.8
Spokane HP	$402.60	169 kWh	92	140	25.2
Spokane Gas	$402.60	16.8 Therms	259	328	23.7

List any **code enforcement** time for additional plan review or inspections that your proposal will require, in hours per permit application:

Small Business Impact. Describe economic impacts to small businesses:

This measure is not predicted to have any economic impacts to small businesses differently than to any other business.

Housing Affordability. Describe economic impacts on housing affordability:

Reduced energy bills and higher resale values are likely to increase housing affordability for average to affordable-housing qualified households.

Other. Describe other qualitative cost and benefits to owners, to occupants, to the public, to the environment, and to other stakeholders that have not yet been discussed:

Homes with better envelope performance have an easier time maintaining a consistent mean radiant surface temperature, improving comfort for residents. Additionally, more advanced window systems typically provide reduced sound transmission, improving quality of life for home residents.

Attachments

Cost of Constructing a Home, NAHB Economics and Housing Policy Group Special Studies, January 2020
ENERGY STAR® Windows, Doors, and Skylights, Version 7.0 Criteria Analysis Report, July 2021
Cost Effectiveness of the Residential Provisions of the 2021 IECC, January 2022
LCCA for Gas Heated Homes, Seattle
LCCA for Gas Heated Homes, Spokane
LCCA for Heat Pump Heated Homes, Seattle
LCCA for Heat Pump Heated Homes, Seattle 40-year